

Claims

Sub B1 → 1. Liquid filtering apparatus in the form of an open or closed vessel containing deep, static beds of coarse granular material such as sand acting as filter medium supported on a porous floor that divides the vessel into an upper turbid liquid chamber with an inlet nozzle or connection and an upper outlet or connection for the removal of bed backwashing liquid and a lower filtrate chamber with a backwashing liquid inlet nozzle and a filtrate outlet nozzle, whereby in operation to remove suspended solids the turbid liquid is preferably passed from top to bottom through the bed after which, and before repeating the cycle, clean liquid such as filtrate is passed through the bed from bottom to top to remove the solids trapped in the bed which leave the container as a suspension through a top outlet nozzle or connection, **thereby characterized**, that the container (1) with an upper turbid liquid feed conduit (12) and a lower filtrate outlet conduit (16) is divided in the vicinity of the level of the pervious horizontal base (2) in such a way that a dependent rim portion(s) (3) of the upper turbid liquid chamber (5) is movable to facilitate the discharge of the bed from the container.

2. Liquid filtering apparatus according to Claim 1, **thereby characterized**, that means are provided to discharge the bed to a bed regeneration device (6), where the bed material is cleaned or cleaned and reactivated and recycled to the turbid liquid chamber (5) of the filtering apparatus (1) for reuse.

3. Liquid filtering apparatus according to Claim 1, **thereby characterized**, that means are provided to discharge the bed to a bed regeneration device (6), where the material of the bed is cleaned or cleaned and reactivated and thence recycled to a dosing device (7/20) and thence to the turbid liquid chamber (5) of the filtering apparatus (1) for reuse.

4. Liquid filtering apparatus according to Claim 1, **thereby characterized**, that means are provided to discharge the bed to a bed regeneration device (6), where the material of the bed is cleaned or cleaned and reactivated and thence recycled to the dosing device (7/20) and thence dosed to the turbid liquid chamber (5) of the filtering apparatus (1) during the filtration operation, whereby the depth of the bed increases incrementally during the operation.

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5. Liquid purifying apparatus and method according to Claims 1-4, *thereby characterized*, that the cleaned or cleaned and reactivated bed before being recycled to the turbid liquid chamber (5) for reuse is mixed with active powdered material such as bleaching earth, ion-exchange resins, activated carbon, etc.

6. Liquid purifying apparatus and method according to Claim 5, *thereby characterized*, that a dosing apparatus (8/19) is employed to dose the active powdered material to the granular material of the bed either before or during the purification operation when the depth of the bed increases incrementally.

7. Liquid filtering and purifying method according to Claims 5, 6, *thereby characterized*, that means are provided to treat the surface of the powdered active material with a surface activating medium to enhance its adhesion to the activated surface of the granular material comprising the bed.

8. Liquid filtering and purifying method according to Claims 1-7, *thereby characterized*, that the liquid to be filtered and/or purified in reservoir (10) is dosed with flocculating substances such as polyelectrolytes before or during the filtration and purifying operation.

9. Liquid filtering apparatus according to Claim 1, *thereby characterized*, that means are provided in the form of a conically perforated distributor (27) that extends over the entire internal cross-section of the turbid liquid chamber (5).

10. Liquid filtering apparatus consisting of

- a section of web of filter medium lying on and supported by a porous support surface;
- cover means with dependent rim section(s) extending downwards, the lower surfaces of which make direct sealing engagement with peripheral portions of the said section of web of filter medium, thus forming an upper turbid liquid chamber;
- a receptacle for filtered liquid located beneath the porous support surface having upstanding rim portions, the upper surfaces of which make sealing engagement with the lower peripheral portions of the section of web of filter medium forming a lower filtrate chamber;

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- means for engaging and disengaging the said lower and upper surfaces of the said upper cover and lower receptacle, thus sealing and releasing respectively the said portions of the filter web;
- conduit means in fluid communication with a source of turbid liquid *and* gas and the interior of the cover means;
- conduit means for removing filtrate from the receptacle for filtered liquid;
- means for interrupting or initiating the flow of liquid or gas in the said conduits;
- means to control the filtration operation consisting of a throttling valve located in the said turbid liquid conduit controlled by a device measuring the differential pressure between the turbid liquid chamber and the receptacle for filtered liquid, as well as means in the form of a gas flow controller, a gas throttling valve and a gas pressure controller in series in the said gas conduit controlling the throughput of filtrate to the receptacle for filtered liquid;
- means to transport filter residue consisting of a web of filter medium in the form of a band,
whereby the band consists of a plurality of sections (201/2/3) providing different degrees of filtrate quality or consisting of different materials;

11. Liquid filtering apparatus according to Claim 10, *whereby* the band consisting of a plurality of sections is provided with the means (204/5/6) for individually removing and replacing each section.

12. Liquid filtering apparatus according to Claim 10, *whereby* sections of the band are used as support for strips of prefabricated filter media from storage means either pre-cut or cut "in-situ" to appropriate length and then introduced to the interior of the turbid liquid chamber (5) to coincide with the pervious horizontal base (2) and sealed at the periphery (402) by the dependent rim portion(s) (3) of the said chamber.

13. Method of liquid purification according to Claim 1, *thereby characterized*, that as support for the bed of granular material a layer of finely powdered filter aid is first of all formed on the section of filter medium in the turbid liquid chamber (5).

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14. Liquid purifying apparatus according to Claims 4/6, *thereby characterized*, that the dosing devices are controlled by a microprocessor (15) from input signals from feed and filtrate instrumentation (13,14).

15. Apparatus and method of filtration control according to the defining preamble of Claim 10, *whereby* means to control the filtration operation consist of a gas flow controller, a gas throttling valve and a gas pressure controller connected in series from a source of compressed gas to the turbid liquid chamber (5) , *thereby characterized*, that the said means are employed to measure the *permeability* of any filter media before or during any liquid filtration or purification operation by introducing and filtering a volume of liquid of *known* quality to the turbid liquid chamber.

16. Apparatus and method of liquid purification control according to Claim 15, *thereby characterized*, that the *quality* of the turbid liquid and filtrate are determined by instrumentation such as (13/14), whereby optionally the data is fed to a microprocessor/process controller (15) to choose and implement the supply of the optional filter medium before or during any liquid purification operation.

17. Apparatus and method of liquid purification control according to Claims 11 - 16, *thereby characterized*, that the optimal *mode* of purification such as direct filtration by textiles, membranes, non-woven material, precoat filtration, deep-bed purification with or without active powdered material, etc. is determined before or during any liquid purification operation.

18. Apparatus according to the defining preamble of Claim 10, *whereby* the means for engaging and disengaging the upper and lower surfaces of the upper cover and lower receptacle consist of laterally positioned fluid driven pistons (304) contained in cylinders (305), the bodies of which are fixed to a load-bearing framework with the

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external extremity of the lubricated shafts (307) connected to sectioned sleeves (301) extending and fixed to the extremities of transverse beams (308) acting on the peripheral part of the upper container (5), *whereby* to ensure movement of the dependent rim portion(s) in the horizontal position, sections of material such as polytetrafluorethylene (302) are fixed to the surfaces of the bodies of the fluid driven cylinders (305) fitted in the space between the cylinder surfaces and the internal surfaces of the reciprocating sleeves (301).

19. Apparatus according to the defining preamble of Claim 10, *whereby* the receptacle for filtered liquid located beneath the porous support surface consists of a recessed plate (505) containing one or a plurality of manually removable medium supporting drainage members (502) preferably consisting of an upper perforated sheet (503) lying flush with the peripheral sealing portions of the plate (505) and integrated with a lower layer or layers of material such as woven mesh or expanded metal sheet (504).

20. Apparatus according to the defining preamble of Claim 10, *whereby* the means for transporting the filter residue in the form of a band is driven by a motor or actuator (702) provided with the facility for reversing the direction of transport of the band to discharge the filter bed or residue at either end of the purifying apparatus.